A LOWER CARBONIFEROUS FAUNA FROM TREVALLYN, NEW SOUTH WALES

by JOHN ROBERTS

ABSTRACT. A Lower Carboniferous (Viséan II_{δ}–III_{α}) fauna from Trevallyn near Gresford, N.S.W., is listed and the age of the fauna briefly discussed. The species considered in detail are: *Fenestella allynensis* sp. nov., *Werriea australis* Campbell, *Eomarginifera tenuimontis* sp. nov., *Marginatia patersonensis* sp. nov., *Cleiothyridina australis* Maxwell, *Kitakamithyris triseptata* (Campbell), *Dielasma picketti* sp. nov., '*Camarotoechia*' sp. B, *Stenoscisma laevis* sp. nov., *Prolecanites* sp., ? *Girtypecten sp.*, *Pernopecten trevallynensis* sp. nov., and *Diodontopteria delicata* sp. nov.

MARINE fossils were first collected from Trevallyn during the geological mapping of the Gresford district (Roberts, 1961). A search of the literature reveals no record of any previous collection from this locality which is situated immediately east of the Paterson–Gresford road 2 miles south of the town of Gresford and approximately 20 miles north of the city of Maitland (text-fig. 1).

Grid references quoted in this paper are from the Dungog One Mile Military Sheet. All fossil locality numbers refer to the palaeontological register at the University of New England, Armidale, N.S.W.

STRATIGRAPHY

The stratigraphy of the Gresford district has been described by Roberts (1961). The Trevallyn fossil localities occur in the Bingleburra Formation, the oldest exposed formation in the Gresford district, which consists dominantly of mudstones and siltstones together with interbedded lithic sandstones, conglomerates and oolitic and crinoidal limestone lenses. Thickness in the type section 7 miles north of Trevallyn is approximately 3,000 feet, the base being unexposed. Near Gresford the formation has two different facies; a bank-type environment in the north containing oolitic and crinoidal limestones grades southwards into a region characterized by conglomerates and coarse lithic sandstones. The Trevallyn localities occur in this southern part of the Bingleburra Formation and are situated towards the top of a stratigraphic section in the Trevallyn fault block (Roberts, 1961, fig. 1) east of Gresford. The fauna is approximately 2,000 feet stratigraphically above the exposed base of the section at Lewinsbrook where there is a rich Upper Tournaisian fossil assemblage (Roberts, 1963). Because of faulting neither the top nor the bottom of the Bingleburra Formation is exposed in this block, but it is clear from the composition of the fauna that the Trevallyn horizons occur high in the formation.

Localities. The Trevallyn localities are situated at the following grid references, L. 233 being highest in the sequence; L. 208 at 573864; L. 270 at 572864; and L. 233 at 570864. The locality bordering the Paterson–Gresford road previously referred to L. 207 (Roberts, 1961) is now incorporated in L. 233. Text-fig. 2 shows the stratigraphic relationships between the three horizons. The L. 233 horizon is exposed in a gully running north-east from Trevallyn quarry. Most fossils have been collected from hard

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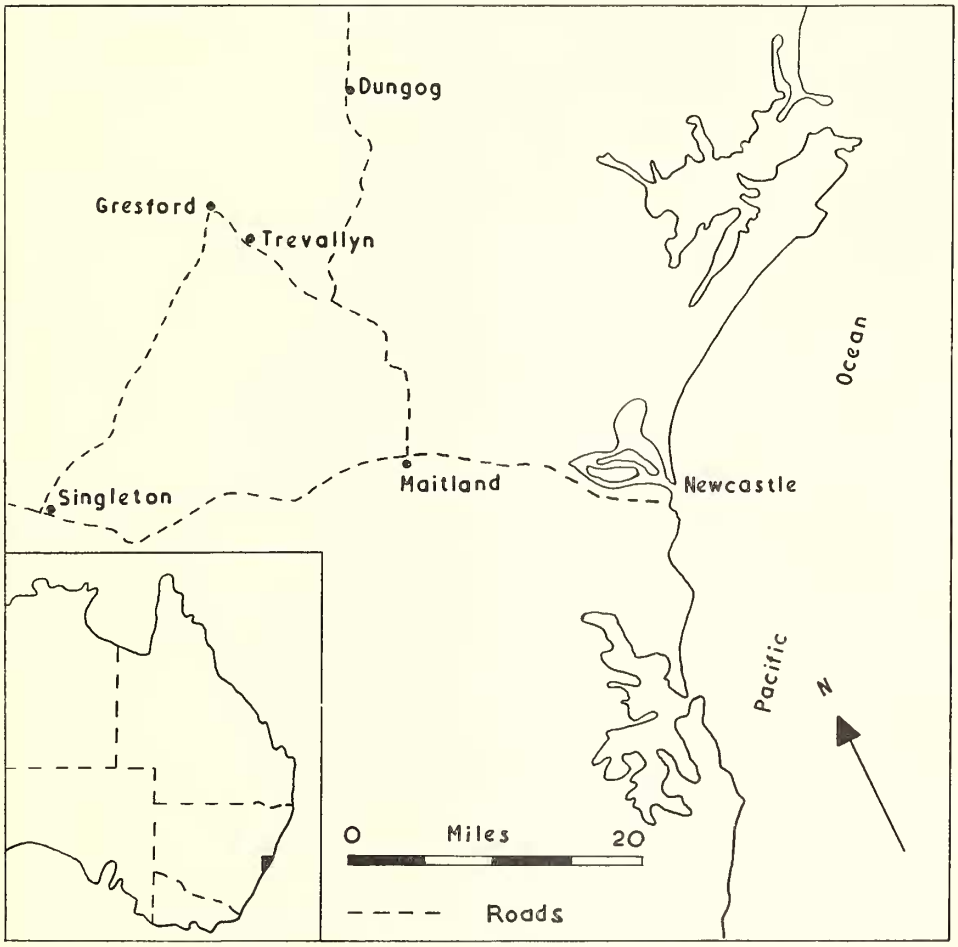
grey siltstone immediately above or below a thin lens of dark fossiliferous limestone containing a small cephalopod fauna (Brown, Campbell, and Roberts, in press). L. 270 is situated at the top of a hill east of Trevallyn quarry and occurs in grey siltstones. The siltstone horizon can be traced approximately half a mile north and south of the L. 270 collecting point. The locality L. 208 is found on the eastern slope of a hill due east from Trevallyn quarry in a bed of coarse calcareous feldspathic sandstone. The bed is lenticular and so the horizon cannot be traced for more than 100 yards.



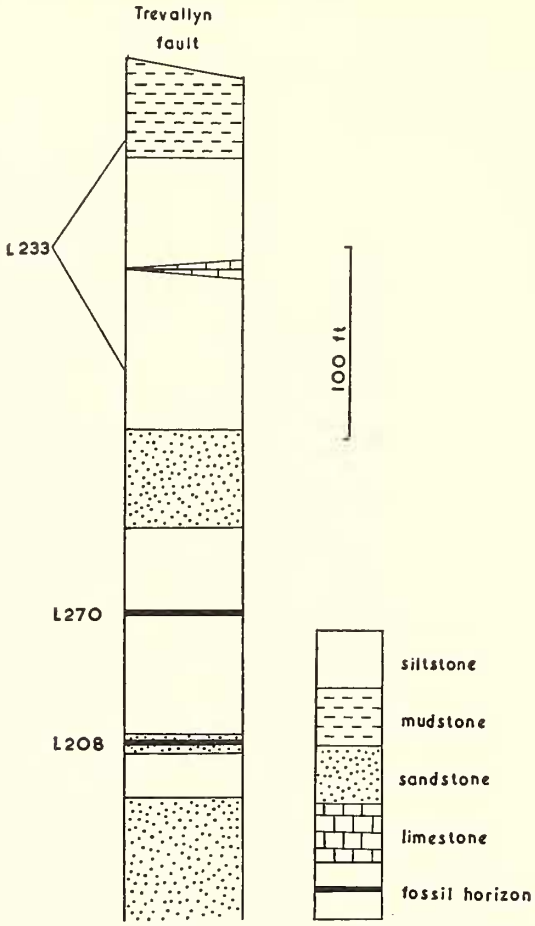
TEXT-FIG. 1. Map showing the position of the Trevallyn area.

FAUNA

The following is a complete list of all identifiable species collected, those forms described in this paper being marked by an asterisk.

L. 233: *Fistulamina inornata* Crockford, **Fenestella allynensis* sp. nov., *Goniocladia laxa* (de Koninck), *Ramipora bifurcata* Crockford, *Cladochonus tenuicollis* M'Coy, *Streptorhynchus spinigera* (M'Coy), *Rhipidomella australis* (M'Coy), *Schizophoria verulamensis* Cvancara, *Leptagonia* cf. *L. analoga* (Phillips), *Rugosochonetes kennedyensis*

Maxwell, *Rugosochonetes sp.*, *Krotovia sp.*, *Fluctuaria sp.*, **Eomarginifera tenuimontis* sp. nov., **Marginatia patersonensis* sp. nov. *Waagenoconcha delicatula* Campbell, **Cleiothyridina australis* Maxwell, **Kitakamithyris triseptata* (Campbell), *Kitakamithyris uniplicata* (Campbell), *Unispirifer striatoconvolutus* (Benson & Dun), *Acuminothyris*



TEXT-FIG. 2. Stratigraphical column of the upper portion of the Lower Carboniferous Bingleburra Formation at Trevallyn.

triangularis Roberts, *Asyrinxia lata* (M'Coy), **Dielasma picketti* sp. nov., **'Camarotoechia'* sp. B., **Stenoscisma laevis* sp. nov., **Girtypecten sp.*, **Pernopecten trevallynensis* sp. nov., **Diodontopteria delicata* sp. nov., *Streblopteria sp.*, **Prolecanites sp.*, *Beyrichoceras trevallyneuse* Brown, Campbell, and Roberts, *Mooreoceras regulare* Brown, Campbell, and Roberts, *Vestinautilus sp.*, *Knightoceras sp.*, *Phillipsia* cf. *P. dungogensis* Mitchell.

L. 270: *Schizophoria verulamensis* Cvancara, **Cleiothyridina australis* Maxwell.

L. 208: *Streptorhynchus spinigera* (M'Coy), **Werriea australis* Campbell, *Schizo-*

phoria verulamensis Cvancara, *Leptagonia* cf. *L. analoga* (Phillips), *Krotovia sp.*, **Eomarginifera tenuimontis* sp. nov., **Marginatia patersonensis* sp. nov., *Waagenoconcha delicatula* Campbell, **Cleiothyridina australis* Maxwell, *Kitakamithyris uniplicata* (Campbell), **Kitakamithyris triseptata* (Campbell), *Brachythyris elliptica* Roberts, *Unispirifer striatoconvolutus* (Benson and Dun), *'*Camarotoechia*' sp. B., *Diodontopteria sp.*, *Platyceras sp.*, *Phillipsia sp.*

The Trevallyn assemblage is quite distinct from the Upper Tournaisian fauna from Lewinsbrook (Roberts, 1963) occurring approximately 2,000 feet stratigraphically lower in the Bingleburra Formation. The Lewinsbrook fauna is characterized by the following species: *Fenestella brownei* Roberts, *F. gresfordensis* Roberts, *F. wilsoni* Roberts, *Bibucia tubiformis* Roberts, *Productina globosa* Roberts, *Pustula multispinata* Roberts, ? *Thomasaria voiseyi* Roberts, *Streblochondria obsoleta* Roberts, and *Conophillipsia brevicaudata* Roberts.

The majority of the species from Trevallyn have also been recorded from L. 53 Greenhills (also known as Hilldale), 1·5 miles south-west of the village of Hilldale. The composition of the Trevallyn fauna suggests that it is slightly older than that from Greenhills. Species present at Trevallyn and absent from Greenhills are: *Fenestella allynensis* sp. nov., *Brachythyris elliptica* Roberts, and *Acuminothyris triangularis* Roberts. *Brachythyris elliptica*, however, appears to be longer ranging than suggested here and has been collected from L. 204 Lewinsbrook Syncline at the base of the Bonnington Formation in the northern part of the district (Roberts, 1961). L. 233 Trevallyn is stratigraphically the highest known locality from which *Acuminothyris triangularis* has been recorded.

AGE OF THE FAUNA

The age of the Trevallyn fauna has been determined as Middle Viséan, possibly upper II_δ or III_α, by Brown, Campbell, and Roberts (in press). This is based on the occurrence of *Beyrichoceras trevallynense* Brown, Campbell and Roberts, which is morphologically similar to *B. submicronotum* Bisat, and *Prolecanites sp.*

Support for the Middle Viséan age is provided by *Werriea australis* Campbell which is very close to *Werriea keokuk* (Hall) from the Keokuk Limestone in the Mississippi Valley, U.S.A. (Campbell, 1957). Collinson *et al.* (1962) have correlated the Keokuk Limestone with the II_δ zone of Germany.

Additional evidence is provided by the presence of the following distinctive species in the Middle Viséan Babbinboon fauna in the Werrie Basin, N.S.W.; *Werriea australis* Campbell, *Waagenoconcha delicatula* Campbell, *Kitakamithyris triseptata* (Campbell), and *K. uniplicata* (Campbell).

Type of preservation. Fossils from L. 208 occur as well-preserved external and internal moulds in the weathered portions of the bed. Shelly material still remains in the unweathered rock and moulds must be prepared by leaching with hydrochloric acid. In weathered parts of L. 233 and L. 270 fossils are preserved as internal and external moulds. Shell material is present in a limestone lens interbedded with the fossiliferous siltstones and also occurs in the unweathered portions of the siltstone bed.

SYSTEMATIC DESCRIPTIONS

Family FENESTELLIDAE King 1850
Genus FENESTELLA Lonsdale 1839

Type species. Fenestella subantiqua d'Orbigny, 1852, from the Wenlock, Dudley, England.

Fenestella allynensis sp. nov.

Plate 13, figs. 5–7

Diagnosis. Fine rectangular mesh; branches wide, flat, bearing a broadly rounded carina with four nodes per fenestrule plus one on dissepiment; fenestrules rectangular; apertures hooded distally; two to three apertures per fenestrule plus one on dissepiment; reverse surface of branches finely striate.

TABLE 1

Specimen Number	*Branches*		*Dissepiments*	*Fenestrules*			*Apertures*			*Nodes*
	Width	*No. in 10 mm.*	*Width*	*Width*	*Length*	*No. in 10 mm.*	*Diameter*	*No. per Fenestrule*	*No. per 5 mm.*	*No. per Fenestrule*
F. 6904	0·3–0·35	17 (8 in 5 mm.)	0·1–0·15	0·3–0·4	0·75–1	8–9	0·15	2–3+1 on dissep.	14–15	4+1 on dissep.
F. 6914	0·25	.. (9 in 5 mm.)	0·1–0·15	0·25–0·3	0·6–0·7	10	0·14	2–3+1 on dissep.	..	4+1 on dissep.
F. 6913	0·3	20	0·15	0·25–0·3	0·65–0·8	10	0·1–0·14	3+1 on dissep.	19	4+1 on dissep.
F. 6905	0·3	16 at base, 19 at top	0·15	0·2–0·3	0·75	10	0·14	3+1 on dissep.	21	4+1 on dissep.
F. 6915	0·3	22–28	0·15	0·25	0·75–0·8	..	0·15	2–4+1 on dissep.	20	4+1 on dissep.

Description. Colony broadly conical with very regular meshwork; bifurcation distant; branches moderately wide, 0·25–0·35 mm., with density of 16–20 per 10 mm. in older portions of colony and 22–28 per 10 mm. in younger portions; reverse surface of branch ornamented with fine longitudinal striae; obverse surface of branch flat below carina; carina broadly rounded, 0·1 mm. wide, moderately high, bearing small pointed nodes having a density of 4 per fenestrule plus one on the dissepiment; apertures sub-circular, 0·1–0·15 mm. in diameter, hooded distally, with narrow peristome and placed well below carina; two to three (occasionally four) apertures per fenestrule plus one on dissepiment, and approximately 14 and 21 apertures per 5 mm. on an older and younger portion of the colony, respectively; fenestrules rectangular to sub-rectangular, from 0·25–0·4 mm. wide and from 0·6–1 mm. long, the latter averaging 0·75 mm.; dissepiments short, thin, 0·1–0·15 mm. long and approximately level with both reverse and obverse sides of branches; zooecia semi-polygonal, closely spaced, with zigzag median interlocking section. For measurements see Table 1.

Remarks. Two Eastern Australian Carboniferous species may be compared with *Fenestella allynensis. F. cellulosa* Crockford (1947) from Barrington House, Barrington

Tops, has a finer meshwork, a longer carina, smaller apertures and a smooth reverse surface. *F. cribriformis* Crockford (1947), from Rouchel Brook, has thinner branches, a more narrow carina and a smooth reverse surface. Of overseas species, *F. serratula* Ulrich described by Condra and Elias (1944) and Koenig (1958) from the Warsaw Beds, Illinois, superficially resembles *F. allynensis*. The Trevallyn species has one additional aperture per fenestrule and a slightly coarser meshwork than that of *F. serratula*.

F. frutex M'Coy, revised by Miller (1961), has morphologically similar apertures, keel, and zooecia, and also has a comparable regularity in the meshwork. However, it is distinguished from *F. allynensis* by its shorter ovoid fenestrules and one or two less apertures per fenestrule. *F. frutex* is common in the Lower Carboniferous rocks of Europe, Turkestan, and North America. These same distinctions apply to *F. tenax* Ulrich (1890), also described by Condra and Elias (1944), from the Mississippian Warsaw and Chester Beds of Illinois.

This species is named after the Allyn River near Gresford, N.S.W. It is known only from the type locality, L. 233 Trevallyn.

Material. F. 6904–F. 6921. *Holotype* F. 6904, *paratypes* F. 6905–F. 6908.

Family SCHUCHERTELLIDAE Stehli 1954
Genus WERRIEA Campbell 1957

Type species. (By original designation) *Werriea australis* Campbell, 1957, from the Namoi Formation, Werrie Basin, N.S.W.

Remarks. Campbell (1957) separated *Werriea* from *Orthotetes* Fischer on the basis of the morphology of the spondylium and median septum in the pedicle valve. He obtained details of *Orthotetes* from Sokolskaya's (1954) redescription of the genus and understood that in young specimens a small 'primary' spondylium formed by the unification of dental plates was prolonged into a median septum. In *Werriea*, the septum and the dental lamellae are completely separate in young stages and become fused in later stages of growth to form a 'secondary' spondylium. Lane (1963), however, was hesitant to accept this difference because Campbell's interpretation was based on one poor text-figure in Sokolskaya (1954), and suggested that *Werriea* may be synonymous with *Orthotetes*.

The genus *Pseudoorthotetes* Sokolskaya (1963) appears to be very close to *Werriea* but is not fully understood by the author. It is distinguished from *Werriea* by the posession of longer 'crural plates' and longer lobes on the cardinal process (Sokolskaya, p. 98). It is not clear whether the 'crural plates' refer to the whole of the socket plates and their buttressing ridges or to only part of these structures. The type of spondylium is also obscure. For the present, *Pseudoorthotetes* is probably best regarded as a junior synonym of *Werriea*.

G. A. Thomas (1958, p. 20) noted that *Permorthotetes* may be synonymous with *Werriea*. Both genera possess the same type of secondary spondylium, but *Permorthotetes* can be distinguished from *Werriea* by the possession of curving divergent socket plates which always have small projections on their anterior extremities, and buttress ridges extending antero-laterally along the floor of the valve from the ends of the socket plates. The socket plates in *Werriea* are recurved, sub-parallel with the hinge and are not supported anteriorly by buttressing ridges.

The relationship of *Permorthotetes* with *Orthotetes* is mainly dependent on the nature of the spondylium in the latter genus, although the distinctive divergent socket plates with distal projections and buttressing ridges in *Permorthotetes* should be sufficient to distinguish between the two genera.

The present material is placed in *Werriea* until the relationship between this genus and *Orthotetes* is clarified.

Werriea australis Campbell

Plate 10, figs. 10–14

Werriea australis Campbell 1957, p. 45, pl. 11, figs. 1–7.

Remarks. The specimens from L. 208 Trevallyn and L. 53 Greenhills agree with Campbell's type material from Babbinboon in all features except those listed below. (1) The number of lirae in the intercostal troughs ranges from 1–5, compared with 1–2 noted by Campbell. (2) The socket plates are only slightly divergent from the hinge in contrast with a divergence of approximately 30° in the type material. (3) Adductor scars in mature brachial valves are moderately impressed and are triangular to flabellate in outline. They have rounded posterior terminations and straight or obsolete anterior margins. These scars were apparently obscure in the type material and were not described.

Occurrence. Werriea australis Campbell is known from L. 35 Babbinboon, the type locality, L. 208 Trevallyn and L. 53 Greenhills.

Material. F. 6789–F. 6800.

Family MARGINIFERIDAE Stehli 1954
Genus EOMARGINIFERA Muir-Wood 1930

Type species. (By original designation) *Productus longispinus* J. Sowerby, 1814, from the Lower Carboniferous of Linlithgowshire, Scotland.

Remarks. Minor features of this material which are not in agreement with the revised diagnosis of the genus (Muir-Wood and Cooper 1960) are as follows: (1) A marginal

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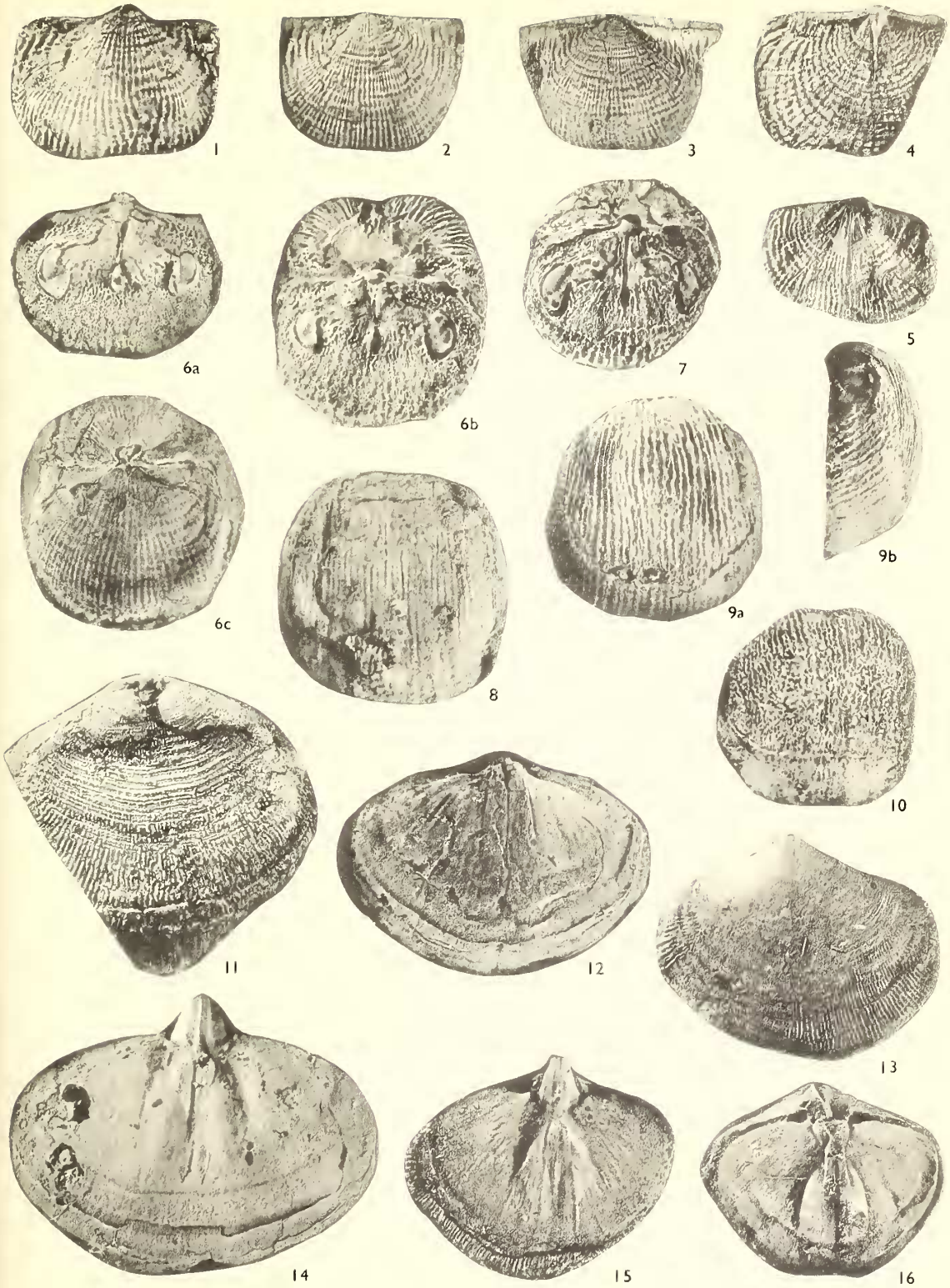
EXPLANATION OF PLATE 10

Figs. 1–5. *Marginatia patersonensis* sp. nov. 1, F. 6828a. Internal mould of pedicle valve, ×1·5. 2, F. 6815. Internal mould of pedicle valve; paratype, ×1. 3, F. 6813. Rubber cast of pedicle valve exterior; note the row of spines along the hinge; holotype, ×1. 4, F. 6817. Rubber cast of brachial valve interior. (L. 53 Greenhills), ×2. 5, F. 6825c. Internal mould of brachial valve, ×1.

Figs. 6–10. *Eomarginifera tenuimontis* sp. nov. 6*a*, F. 6701. Rubber cast of brachial valve interior; holotype, ×1·6. 6*b*, F. 6701. Internal mould of the same valve and apex of pedicle valve; holotype, ×1·6. 6*c*, F. 6701. Rubber cast of brachial valve exterior and apex of pedicle valve; holotype, ×1·6. 7, F. 6704. Rubber cast of brachial valve interior, ×1·6. 8, F. 6825a. Rubber cast of pedicle valve exterior, ×1·5. 9*a*, F. 6708. Internal mould of pedicle valve; paratype, ×1·7. 9*b*, F. 6708. Lateral view of the same specimen; paratype, ×1·7. 10, F. 6717. Internal mould of pedicle valve showing well-developed marginal ridge, ×1·5.

Figs. 11–16. *Cleiothyridina australis* Maxwell 11, F. 6688. Rubber cast of pedicle valve exterior, ×2. 12, F. 6684. Internal mould of brachial valve, ×2. 13, F. 6687. Rubber cast of pedicle valve exterior, ×1·6. 14, F. 6686. Internal mould of pedicle valve, ×2. 15, F. 4815. Internal mould of pedicle valve, ×2. 16, F. 6689. Internal mould of pedicle valve and apical part of brachial valve, ×2.



ROBERTS, Australian Carboniferous fauna

ridge is present on the interior of some, but apparently not all, pedicle valves. (2) In the region between the adductor scars on the brachial valve the median septum has a variable strength but is usually stronger than the 'thread-like breviseptum' in the type material. (3) The type material may be more strongly spinose on the interior of the brachial valve.

Eomarginifera tenuimontis sp. nov.

Plate 10, figs. 6–10

Diagnosis. Shell average size for genus; hinge-line produced into small auricles; fourteen to fifteen costellae per 10 mm. on median anterior portion of shell; six to eight concentric ribs on posterior half of brachial valve; ribs weaker on pedicle valve; occasionally a marginal ridge in pedicle interior; two pairs of adductor scars in brachial valve; brachial ridges enclosing kidney-shaped brachial impressions; cardinal ridge 10°–15° divergent from hinge.

Description. External. Shell of average size for genus, strongly concavo-convex, globular to rectangular, with a long steep trail; hinge-line straight, approximately equal in width to widest part of shell, and bearing small flattened auricles on its lateral extremities; costellae well defined on body of shell but becoming faint towards tip of umbo on pedicle valve and on steep posterior portions of brachial valve; density of costellae 14–15 per 10 mm., measured laterally on median anterior portion of shell; costellae increase by intercalation and bifurcation; six to eight concentric ribs on posterior half of brachial valve more strongly defined than those on same region of pedicle valve; six large halteroid spines regularly placed on pedicle valve, two on lateral slopes, two on ears, and two on median anterior portion of valve; brachial valve aspinose.

Pedicle valve with a convex visceral disc, steep flanks and an incurved umbo extending 4 mm. behind hinge-line on a valve 19 mm. wide and 21 mm. long; sinus shallow at umbo and running as a narrow obsolete furrow towards front of valve.

Brachial valve strongly concave, with deepest portion near the umbo; posterior borders slightly convex and slope steeply into the concavity; median fold commences at the umbo and becomes broader but less well defined anteriorly.

Internal. Pedicle valve. Muscle field situated a short distance from beak; adductor scars elevated, vary from narrow rectangular ridges to broad platforms and in some cases divided by a median groove; posterior margins faintly dendritic and slightly impressed into thickened umbonal region; diductor scars divergent, triangular, slightly impressed, with irregular anterior and posterior terminations; they extend a short distance in front of adductor platform; diductor scars ornamented by radial striae in some cases continuous with internal ornament of valve; marginal ridge originates near inner portion of ears, extends around the trail, but may be almost totally obsolete; internal surface of most valves marked by three types of ornament—sharp radial ridges separated by narrow grooves around the muscle field; very small pits on a region extending from front of muscle field to the marginal ridge; obsolete longitudinal ornament on the trail.

Brachial valve. Median septum arises from the rounded base of the cardinal process and extends as a thin sometimes spinose ridge to mid-point of valve where it expands into a high knob-like inflation; strength of posterior portion variable; adductor scars in

two distinct pairs; posterior scars rectangular, elevated on platforms at posterior end of median septum and marked by an obsolete dendritic pattern; smaller anterior scars slightly impressed and situated immediately behind knob-like tip of median septum; brachial ridges arise from antero-lateral margins of posterior adductor scars and run a short distance antero-laterally before making hook-like curves, enclosing kidney-shaped brachial impressions; brachial ridges well defined and high on inner margin of curve around brachial impressions, but elsewhere narrow; floor of valve smooth between brachial impressions and anterior adductor scars; cardinal process bilobate internally, trilobate externally and supported by broad rounded ridges; cardinal ridges diverge at 10°–15° from hinge and run across inner margins of auricles and around anterior margin of valve; surface of visceral disc ornamented by fine pustules, and trail by occasional longitudinal ridges.

Measurements (in mm.)

Pedicle valve:

Specimen Number	*Length*	*Width*	*Height*	*Muscle Field*	
				Length	*Width*
F. 6708	22	20	9	..	..
F. 6709	16·5	20	7	..	..
F. 6717	19	22	7	..	..
F. 6717*b*	..	20	..	10	13
F. 6717*c*	20	20	10	10	15

Brachial valve:

Specimen Number	*Length*	*Width*	*Length of Median septum*	*Distance between external margins of Brachial Ridges*
F. 6701	15	21	7·5	15
F. 6704	15	18	8	14·5
F. 6825*b*	18 est.	24	9	17·5
F. 6705	14 est.	18	8	13·5

The width is measured at the mid-point of each valve.

Remarks. Eomarginifera paradoxus (Campbell, 1957) from Babbinboon, N.S.W., is distinguished from *Eomarginifera tenuimontis* by the presence of a ginglymus, weaker brachial ridges and impressions and differences in ornament. Costellae are slightly finer on *E. paradoxus* and have a density of 16–20 per 10 mm., compared with 14–15 per 10 mm. on *E. tenuimontis*, both measurements being made on the anterior portion of the trail. Concentric ribs are much reduced in *E. tenuimontis* and only 6–8 are present on the posterior third of the pedicle valve, compared with 13–17 on the same region of *E. paradoxus*.

Eomarginifera longispinus (Sowerby) described by Muir-Wood (1928) from the Viséan of Great Britain has a weaker median septum, less well-defined brachial ridges and impressions and a more globose pedicle valve.

Eomarginifera setosa (Phillips) described by Muir-Wood (1928) is characterized by

a weaker posterior portion on the median septum and a stronger marginal ridge in the brachial valve.

Eomarginifera derbiensis (Muir-Wood, 1928) is more convex than *E. tenuimontis*, but because its internal structures are unknown a more detailed comparison cannot be made. Both *E. setosa* and *E. derbiensis* occur in the Viséan and Namurian of Great Britain.

The specific name is taken from the Latin *tenuis*—thin, and *montia*—ridge, and refers to the thin or narrow brachial ridges between the brachial discs and the muscle field.

Occurrence. Eomarginifera tenuimontis occurs at L. 208 and L. 233 (the type locality) Trevallyn and L. 53 Greenhills. Specimens closely resembling this species have been collected from L. 215, L. 216, L. 217, and L. 86 Lewinsbrook (Roberts, 1963).

Material. F. 6701–F. 6724, F. 6825*a–b*. *Holotype* F. 6701, *paratypes* F. 6708, F. 6709.

Family BUXTONIIDAE Muir-Wood and Cooper 1960
Genus MARGINATIA Muir-Wood and Cooper 1960

Type species. (By original designation) *Productus fernglenensis* Weller 1909, from the Fern Glen Formation, Missouri.

Remarks. Only three features of this material do not conform with those of the type species: (1) A single row of small erect spines occurs along the hinge on the pedicle valve. (2) The ears are well differentiated from the visceral disc. (3) Adductor scars in the brachial valve may be divided into two pairs and are not marked dendritically.

The remainder of the characters described below are closely comparable with those of the type species. The external ornament on the brachial valve is strikingly similar to that of *Marginatia* cf. *M. burlingtonensis* (Hall) and *Marginatia sp.* figured by Muir-Wood and Cooper (1960, pl. 99, figs. 5, 13, respectively).

Marginatia patersonensis sp. nov.

Plate 10, figs. 1–5

Diagnosis. Pedicle valve transverse to subquadrate; shallow sinus extending from near umbo to anterior margin of valve; hinge extended into blunt, flattened auricles; costae with density of 12–14 per 10 mm. at anterior margin; rugae prominent on ears and up to 16 present on visceral disc; erect row of fine spines along hinge; brachial valve geniculate, with fold crossing trail and visceral disc; adductor scars smooth and possibly divided into two pairs.

Description. External. Pedicle valve transverse to subquadrate; strongly convex on posterior portion of valve and on trail; hinge widest part of valve and extended into blunt flattened auricles; umbo pointed, slightly incurved over hinge and well differentiated from flattened postero-lateral margins; flanks steep; shallow sinus extends from near umbo to anterior margin of valve; costae twice as wide as separating sulci, and especially well defined on trail; costae with density of 12–14 per 10 mm. at anterior margin of valve, increasing mainly by intercalation; rugae pronounced on ears, and up to 16 rugae ornament the visceral disc, forming a well-defined reticulate pattern; rugae do not extend on to trail; spines present in fine erect row along hinge, a group of two or three slightly larger spines on postero-lateral margins, and a row of larger spines with circular bases

on anterior portion of trail; other small anteriorly pointing spines, arising from costae, randomly distributed over visceral disc.

Brachial valve geniculate, with gently concave visceral disc; valve increases in concavity at trail; postero-lateral margins sharply defined from visceral disc; umbo depressed below level of hinge; fold crosses both visceral disc and trail; costae have same density as those on pedicle valve; a variable number of rugae present on visceral disc give rise to a marked reticulate ornament; rugae obscure costae on umbo and are absent from trail; several small spine bases present on lateral margins; small pits occur in positions corresponding with spines on body of opposite valve.

Internal. Pedicle valve. Muscle scars poorly defined and obscured by impressions of external ornament; ginglymus apparently absent; marginal ridge arises at postero-lateral extremities of valve and crosses the venter at anterior margin of visceral disc.

Brachial valve. Adductor scars may be divided into two pairs; inner scars elongate, smooth, pointed posteriorly and broadly rounded anteriorly; second pair more obscure, may occur on lateral margins of those described above and appears to be longitudinally striate; median septum extends at least two-thirds length of visceral disc, being broadly rounded at posterior of valve and becoming narrow and blade-like for anterior three-quarters of its length; septum bears narrow median furrow on rounded posterior portion and a small antron in front of cardinal process; cardinal process bilobate anteriorly; posterior surface not observed; lateral ridges well defined and slightly divergent from hinge-line; brachial ridges arise on antero-lateral margins of lateral adductor scars, but are only well defined when surrounding brachial discs; brachial discs large smooth ovoid impressions, their anterior margins being level with tip of median septum; postero-lateral margins of valve ornamented with fine pustules; remainder of internal surface more regularly and coarsely spinose in front of muscle scars and brachial impressions; granulated radial ribs present between large spine bases on anterior of shell; on some specimens internal ornament obscured by impressions of external ornament.

Measurements (in mm.)

Pedicle valve:

Specimen Number	*Width at mid-point*	*Length*
F. 6813	27	22
F. 8030	25	20
F. 6826*a*	22	18

Brachial valve:

Specimen Number	*Width at mid-point*	*Length*
F. 7196	31·5	23
F. 6815	17	15
F. 6817	20	15 est.
F. 6825*c*	28	21·5

Remarks. Differences with the type species have been outlined above.

Marginatia burlingtonensis (Hall), described by Weller (1914) from the Burlington

Limestone of Iowa, Missouri, and Illinois, is larger, more inflated, has a longer trail on the pedicle valve, and lacks a row of spines along the hinge of the pedicle valve. *M. burlingtonensis* has a similar style of ornament, and one notable similarity is its possession of well-defined auricles on the pedicle valve; the pedicle valve has a sulcus comparable with that on *M. patersonensis*. *Marginatia* cf. *burlingtonensis* (Hall) from Lake Valley, New Mexico (Muir-Wood and Cooper, 1960), is distinguished from this species by a coarse costate ornament on the pedicle valve, a more globose shape, the absence of a sulcus and well-defined auricles on the pedicle valve, and a weaker posterior portion on the median septum. *Marginatia sp.*, illustrated by Muir-Wood and Cooper (1960), also from New Mexico, is larger than this species, has a finer and more reticulate ornament, dendritic adductor scars in the brachial valve, and lacks ears on the pedicle valve.

This species is named after the Paterson River, near Gresford, N.S.W.

Occurrence. Marginatia patersonensis has been collected from L. 86, L. 215, and L. 217 Lewinsbrook, L. 50 Gresford Quarry, L. 53 Greenhills, L. 204 and L. 206 Lewinsbrook Syncline (Roberts, 1961), and L. 208 and L. 233 Trevallyn (the type locality).

Material. F. 6812–F. 6826. F. 7196–F. 7200. F. 8030–F. 8032. *Holotype* F. 6813, *paratype* F. 6815.

Family ATHYRIDAE Davidson 1884
Genus CLEIOTHYRIDINA Buckman 1906

Type species (By original designation) *Spirifer deroysii* L'Eveillé 1833, from Tournai, Belgium.

Remarks. From recent unpublished work mentioned by Sanders (1958) it appears that the type species of *Cleiothyridina* requires revision to clarify the taxonomic status of the genus. At present there is confusion between *Cleiothyridina* and *Actinoconchus* M'Coy. *Actinoconchus*, as recently interpreted by Sarycheva (1960) after Davidson (1857), has its concentric lamellose ornament crossed by radial striae. According to Hall and Clarke (1894) the striae were formed by fine tubular spines, but this cannot be confirmed until the type species, *A. paradoxus* M'Coy, has been revised.

The anterior portions of *Cleiothyridina australis* Maxwell, described below, have the appearance of being radially costate, a state of affairs which could possibly suggest an affinity with *Actinoconchus* M'Coy. However, a close examination of the external ornament reveals the posterior half of the shell to be ornamented with concentric lamellae bearing very small flattened spines and the anterior half to possess long flat radially arranged overlapping spines. The overlapping of these spines first occurs in the region where growth lamellae become crowded. When the spines are broken their bases produce a pseudocostate surface ornament.

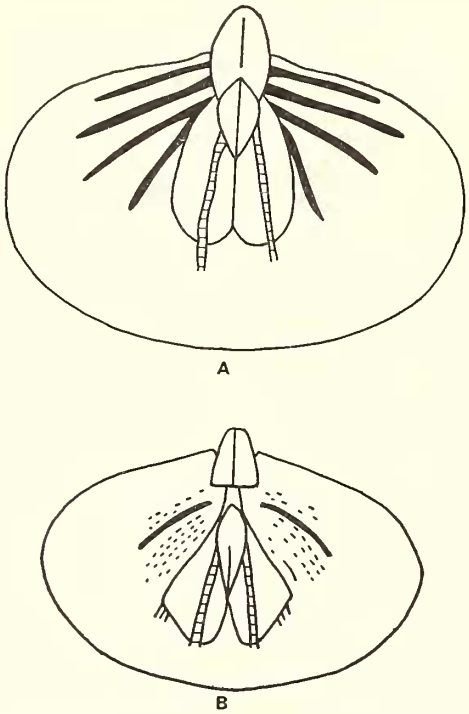
Cleiothyridina australis Maxwell

Plate 10, figs. 11–16; text-figs. 3–4

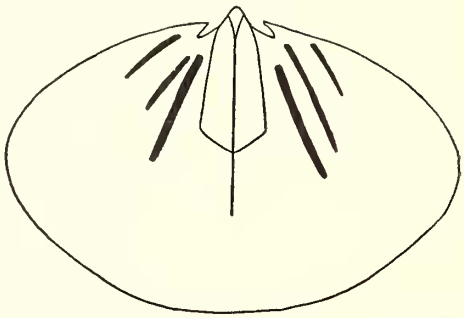
Cleiothyridina australis Maxwell 1954, p. 43, pl. 5, figs. 5–6.

Description. External. Shell sub-equally biconvex, moderately transverse, two-thirds wider than long, and elliptical to sub-elliptical; greatest width at mid-line; hinge-line slightly curved and one-half to two-thirds width of shell; ornament of regular imbricating

concentric lamellae, anterior margins of which produced into an overlapping fringe of flat spines; spines become coarser and more elongate anteriorly and project from anterior and antero-lateral margins; on anterior half of shell spines regularly produced into radial rows and when broken give the shell a costate appearance; elongate spines generally confined to anterior half of pedicle valve and may extend a short distance further posteriorly on brachial valve; twenty to thirty concentric lamellae and twelve to fifteen spine bases per 5 mm. on mid-anterior portion of brachial valve.



TEXT-FIG. 3. *Cleiothyridina australis* Maxwell. Internal view of the pedicle valve showing pallial markings. Vascula genitalia black, vascula media ruled (A. F. 6686, B. F. 4815, both × 2).



TEXT-FIG. 4. *Cleiothyridina australis* Maxwell. Showing the trunks of vascula genitalia in the brachial valve (F. 6684, × 2).

Pedicle valve. Beak moderately incurved and containing a sub-circular foramen; umbo slightly elevated and shoulders slope evenly to lateral margins; median sinus faint near umbo, widens into a broader but more shallow depression towards front of valve and may become obsolete anteriorly; delthyrium broad, triangular, having lateral margins convex outwards; delthyrium filled by umbo of brachial valve.

Brachial valve slightly less convex than pedicle valve, with weaker incurved umbo; fold faintly developed; lateral margins flattened.

Internal. Pedicle valve. Teeth supported by blunt peg-like dental lamellae emerging from near antero-lateral margins of pedicle cavity; dental lamellae run a short distance laterally and do not extend around muscle field; pedicle cavity rounded to V-shaped, expands anteriorly and narrows posteriorly; floor of cavity divided by three longitudinal grooves; shell thickened around front of pedicle cavity and posterior portions of muscle

field; muscle field deeply impressed posteriorly and divided by an expanding myophragm which usually runs length of muscle field; myophragm completely obsolete in some specimens; adductor scars triangular to rectangular, occurring at posterior end of muscle field; diductor scars large, generally less well impressed, and rectangular to triangular in shape; pointed posterior margins of diductor scars situated slightly behind mid-point of adductor scars; their broadly rounded to almost straight anterior margins usually well in front of adductor scars, up to eight radiating blade-like trunks of vascula genitalia diverge from thickened area on postero-lateral margins of muscle field and become obsolete in mid-portions of valve; two trunks of vascula media draped from lateral margins of adductor scars over diductor scars and then run towards anterior margin of valve; faint genital pits present on thickened areas on either side of muscle field; the pattern of pallial markings is shown in text-fig. 3.

Brachial valve. Hinge-plate apically perforated, triangular, and linking the crural plates; crurae widely divergent, well rounded, concave outwards, and highest at their anterior extremities; sockets trough-like, rounded, and widely divergent; median septum commences from beneath hinge-plate as a thick broadly rounded ridge bearing a median carina, weakens abruptly a short distance behind its mid-length and continues as a sharp ridge to mid-point of valve; adductor scars elongate, deeply impressed and bluntly rounded posteriorly, broaden slightly anteriorly and terminate obscurely near end of median septum; each scar divided by a divergent longitudinal line, the inner portion of scar being more deeply impressed than the outermost division; trunks of vascula genitalia diverge from postero-lateral margins of muscle field in a faint radial pattern and rapidly become obsolete towards margins of valve (text-fig. 4).

Measurements (in mm.)

Pedicle valve:

Specimen Number	*Length*	*Width*	*Muscle Field*	
			Length	*Width at Anterior End*
F. 4815	16	23	9	7·5
F. 6686	21	28·5	11·5	8
F. 6688	21	30	..	..
F. 6698	13	19	7	7
F. 6687	21	27·5	..	..

Brachial valve:

Specimen Number	*Length*	*Width*	*Length Median Septum*	*Muscle Field*	
				Length	*Width*
F. 6684	19	26	12·5	8 approx.	4
F. 6689	21	26	..	..	..

Remarks. This material differs slightly from the Mt. Morgan specimens described by Maxwell (1954) in its finer concentric lamellose ornament, a more transverse shape, more deeply impressed muscle scars in the pedicle valve and a stronger median septum in the brachial valve.

Maxwell (1954) discusses the relationship of *C. australis* with overseas species.

Occurrence. Cleiothyridina australis Maxwell is known from the *Schizophoria* Zone of the Neils Creek Clastics, Mt. Morgan district, Queensland, L. 53 Greenhills and L. 204 Lewinsbrook Syncline (Roberts, 1961), and L. 233, L. 270, L. 208 Trevallyn.

Material. F. 4813–F. 4818. F. 6684–F. 6700.

Family SPIRIFERIDAE King 1846
Genus KITAKAMITHYRIS Minato 1951

Type species. (By original designation) *Kitakamithyris tyoanjiensis* (Minato), 1951, from the Hikoroiti series, North East Honsyu, Japan.

Remarks. On present knowledge it is difficult to distinguish between the genera *Kitakamithyris* and *Phricodothyris* George. This problem has been dealt with at length by Maxwell (1961) and has been briefly mentioned by Campbell (1961).

Maxwell considered that *Kitakamithyris* Minato could be distinguished from *Phricodothyris* George by the possession of larger radially arranged spine bases, a lack of interspinous pustules and the presence of dental lamellae and a long median septum in the pedicle valve. However, he doubted (p. 98) that minor details of the surface ornament could be successfully used to distinguish between phricodothyroid genera, because of the results of George's (1932) work on the British phricodothyroids. His interpretation is therefore based on the fact that all of the species so far described from Eastern Australia and Japan possess well-defined dental lamellae and a median septum in the pedicle valve. In contrast, the British species of *Phricodothyris* show great variability of internal structures.

Campbell (1955, 1961) placed species from N.S.W. in the genus *Phricodothyris*, but (1961, p. 437) noted that 'the invariable development of strong dental lamellae, ventral adminicula, and median septa, may yet require the removal of the New South Wales species from *Phricodothyris* and their inclusion in *Kitakamithyris*'. He also maintained that revision of the European phricodothyroids is required before the two genera can be successfully distinguished.

Until conclusive evidence is forthcoming the author accepts Maxwell's interpretation and assigns this material to *Kitakamithyris*.

The spines on the specimens of *Kitakamithyris triseptata* (Campbell) described below consist of a pair of divided tubes which are incompletely closed anteriorly. The dividing split between the two tubes is clearly visible on the surface facing the shell. Transverse barbs are also present. With the exception of the last mentioned feature the spines are identical with those described by Campbell (1961) on *Phricodothyris immensa* Campbell. This type of spine is different from the completely closed tube-like structure described by George (1932) for the British species of *Phricodothyris*, and from those of the type species of *Kitakamithyris* figured by Minato (1952, pl. 9, figs. 4*c*, 4*d*) which also appear to be completely closed.

Kitakamithyris triseptata (Campbell)

Plate 11, figs. 1–3

Phricodothyris triseptata Campbell, 1955, pp. 379–380, pl. 18, figs. 10–15.

Description. Campbell's original description can be supplemented by the following observations:

External. Pedicle valve. Ornament of six to seven concentric lamellae per 10 mm. and five to six biramous spine bases per 5 mm., measured on median anterior portion of valve; faint radial lirae in line with spine bases; spines barbed, tubular and biramous, divided down their mid-length by a narrow furrow and incompletely closed anteriorly; base of spine broad; spines sharply pointed distally, up to 5 mm. long at anterior margin of valve; interarea strongly coneave, 2·5 mm. high on a shell 23·5 mm. wide and 16 mm. long, and ornamented with fine vertical striae; delthyrial angle approximately 60°.

Internal: Pedical valve. Diductor scars smooth, commence at tip of umbo, well defined only where surrounded by adminicula and become poorly impressed and obsolete anteriorly; adductor scars narrow and not extending posteriorly as far as the diductor scars.

Brachial valve. Adductor scars shallowly impressed, rectangular to quadrangular, expanding slightly anteriorly and extending almost the entire length of median ridge; cardinal process approximately 15 small vertical lamellar platelets.

Remarks. Differences between the Trevallyn specimens and those from Babbinboon, N.S.W., described by Campbell (1955), are of a minor nature. The median ridge in the brachial valve is longer and the angle of divergence of the adminicula smaller in the Trevallyn specimens.

Occurrence. Kitakamithyris triseptata (Campbell) has been collected from L. 35 Babbinboon (the type locality), L. 53 Greenhills and L. 204 Lewinsbrook Syncline (Roberts, 1961) and L. 208 and L. 233 Trevallyn.

Material. F. 6613–F. 6626.

Family DIELASMATIDAE Schuchert and Le Vene 1929
Genus DIELASMA King 1859

Type species. (By original designation) *Terebratulites elongatus* Schlotheim, 1816, from Pössneck, Thuringia, Germany.

Dielasma picketti sp. nov.

Plate 12, figs. 1–3

Diagnosis. Shell slightly longer than wide; commissure gently sinuate; cardinal margin terebratulid; pedicle valve with sub-erect umbo; foramen mesothyrid to permesothyrid; small disjunct deltidial plates at apex of delthyrium; palintrope gently concave; pedicle interior with large curving teeth; hinge-plate extending half the length of brachial valve.

Description. External. Shell equally biconvex, slightly longer than wide, terebratuliform in shape, lacking a fold and sinus and with gently sinuate commissure; ornament restricted to irregular concentric growth lines; punctae evenly distributed, having a density of approximately 300 per square mm. on internal surface of shell.

Pedicle valve with sub-erect umbo perforated by a mesothyrid to permesothyrid foramen; pedicle collar well defined; cardinal margin terebratulid; small disjunct deltidial plates restricted to apex of delthyrium; palintropes gently convex, extending some distance laterally and separated from body of shell by strong beak ridges.

Brachial valve. Area of greatest convexity towards posterior of valve; umbo pointed but not incurved.

Internal. Pedicle valve. Teeth large, curved, antero-laterally directed and supported on strong dental lamellae; dental lamellae broadest at floor of valve and extending a short distance anteriorly as small ridges; muscle scars not observed.

Brachial valve. Hinge-plate resting medially on floor, forming a shallow spoon-like structure, and extending almost to mid-point of valve; hinge-plate joins with socket plates and bears triangular divergent crural bases mid-way between socket plates and floor of the valve; adductor scars in two pairs; inner scars elongate, rectangular and slightly divergent anteriorly; anterior margins of adductor scars grade into trunks of vascula myaria; posterior margins not observed; outer adductor scars rectangular but less well defined; thick divergent vascula myaria trunks arise from anterior margins of inner adductor scars and extend towards the anterior margins of the valve; cardinal process not observed.

Measurements (in mm.)

Pedicle valve:

Specimen Number	*Length*	*Width*
F. 6669	18	15
F. 6670	17·5	14

Brachial valve:

Specimen Number	*Length*	*Width*
F. 6669	16	15
F. 6673	15·5	13
F. 6674	16·5	13

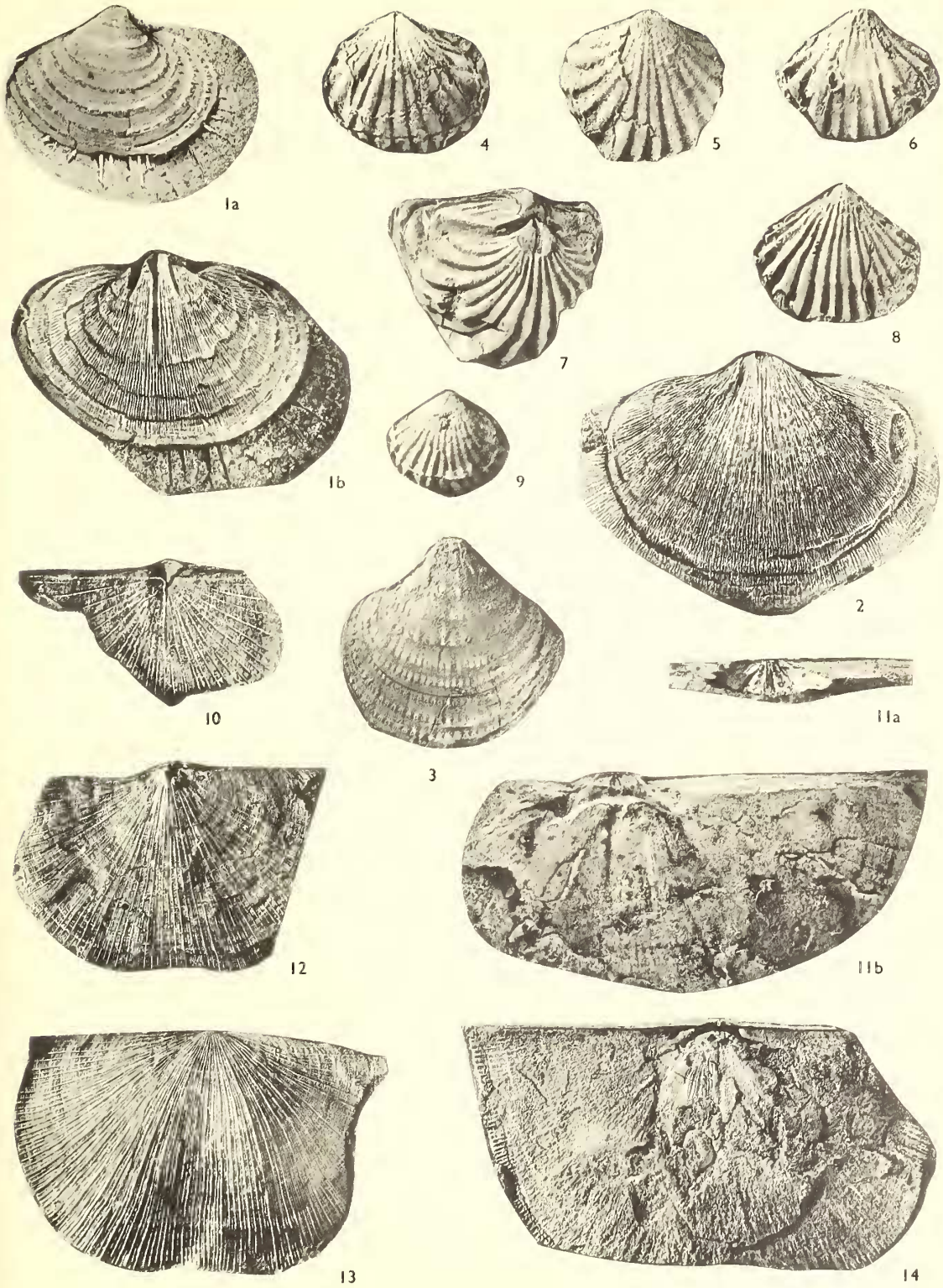
Remarks. The species *Dielasma sacculum* var. *hastata* (Sowerby) described by Dun (1902) from Wallaroo Hill, Clarencetown, N.S.W., is of doubtful validity. Insufficient detail is available for a comparison of this species with *D. picketti*. The only comparable overseas form appears to be *D. avellana* (de Koninck) from the Viséan of the Moscow Basin (Sarycheva and Sokolskaya, 1952). It has a similar external shape but cannot be

EXPLANATION OF PLATE 11

Figs. 1–3. *Kitakamithyris triseptata* (Campbell) 1*a*, F. 6613. Rubber cast of pedicle valve exterior showing spinose ornament, ×1·5. 1*b*, F. 6613. Internal mould of pedicle valve, ×2. 2, F. 6617. Internal mould of brachial valve, ×2. 3, F. 6620a. Rubber cast of pedicle valve exterior, ×1·5.

Figs. 4–9. '*Camarotoechia*' sp. B, 4, F. 6892a. Internal mould of brachial valve, ×2. 5, F. 6898. Rubber cast of brachial valve exterior, ×2. 6, F. 6884. Internal mould of pedicle valve, ×2. 7, F. 6894. Internal mould of brachial valve and apical portion of pedicle valve, ×2. 8, F. 6888. Internal mould of pedicle valve, ×2. 9, F. 6896. Rubber cast of brachial valve exterior, ×2.

Figs. 10–14. *Werriea australis* Campbell 10, F. 6796. Internal mould of apical portion of pedicle valve; note the spondylium and septum. (L. 53 Greenhills), ×2·5. 11*a*, F. 6793. Rubber cast of cardinal process and cardinal area, ×1. 11*b*, F. 6793. Rubber cast of brachial valve interior showing the muscle field and cardinal process, ×1. 12, F. 6789. Internal mould of pedicle valve; note the short septum and spondylium, ×1. 13, F. 6792. Rubber cast of brachial valve exterior, ×1. 14, F. 6797. Internal mould of brachial valve. (L. 53 Greenhills), ×1.



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compared in detail because its internal structures are unknown. *D. picketti* is named after Dr. J. W. Pickett.

Occurrence. This species has been collected from L. 215 Lewinsbrook, L. 208 and L. 233 (the type locality) Trevallyn and L. 53 Greenhills.

Material. F. 6669–F. 6683. *Holotype* F. 6669, *paratype* F. 6670.

Family CAMAROTOECHIIDAE Schuchert and Le Vene 1929
Genus CAMAROTOECHIA Hall and Clarke 1893

Type species. (By original designation) *Atrypa congregata* Conrad, 1841, from the Skaneateles Formation of New York.

Remarks. As a result of the work of Sartenaer (1961) the concept of *Camarotoechia* has been restricted and the genus is now confined to a small number of Devonian forms. It should not strictly be applied to the species described below but until the Carboniferous rhynchonelloid genera have been revised this material is best referred to '*Camarotoechia*'.

'*Camarotoechia*' sp. B

Plate 11, figs. 4–9

Rhynchonella pleurodon (Phillips), Dun, p. 82, pl. 23, figs. 10–11.

Description. External. Shell small to moderate size for the genus, globular to subtriangular and subequally biconvex; slightly wider than long, with well-rounded anterior and antero-lateral margins; five acutely angular plications on each lateral slope increasing in size away from the umbo; commissure serrated and uniplicate.

Pedicle valve noticeably triangular, with narrow pointed umbo extending a short distance behind the hinge; floor of sinus ornamented by four to five plicae; towards the anterior margin the sinus slopes steeply to commissure, extending as a tongue-like projection into the fold of the brachial valve; no details of foramen or delthyrium observed.

Brachial valve globular to rounded and more inflated than pedicle valve; median fold weak, commences near mid-point of valve and ornamented by usually four or sometimes five plicae; lateral slopes moderately convex and extending evenly to lateral margins; beak incurved.

Internal. Pedicle valve. Teeth broad, well defined and supported by short divergent dental lamellae; muscle scars not observed.

Brachial valve. Median septum slender, extends for approximately one-third the length of the valve and supports a small V-shaped septalium; apical hinge-plate divided, triangular, and bounds inner surfaces of sockets with its concave postero-lateral margins; sockets broad, divergent and strongly serrated.

Remarks. '*Camarotoechia*' sp. A described by Roberts (1963) from Lewinsbrook, N.S.W., is smaller, less transverse and has more broadly rounded plicae.

Insufficient material is available for a detailed comparison to be made with the Western Australian Carboniferous '*Camarotoechia*' species described by Veevers (1959).

Occurrence. This species has been collected from L. 208 and L. 233 Trevallyn, L. 53 Greenhills, L. 204 Lewinsbrook Syncline and also occurs at Clarencetown, N.S.W.

Material. F. 6885–F. 6899.

Family STENOSCISMATIDAE Muir-Wood 1955
Genus STENOSCISMA Conrad 1839

Type species. (By original designation) *Terebratula schlotheimii* von Buch, 1834, from the Permian of Germany.

Remarks. Carboniferous species belonging to this genus have previously been assigned by many workers to *Camarophoria* King, a junior objective synonym of *Stenoscisma*.

Sarycheva and Sokolskaya (1952) divided *Camarophoria* into two sub-genera. *Camarophoria* sensu-stricto and *Levicamera* Grabau, but Cooper (1956) showed that *Levicamera* Grabau was invalid because the designated type species remains undescribed. Cooper erected a new genus *Psilocamara* to embrace forms previously referred to *Levicamera*.

This material is distinguished from *Psilocamara* Cooper (1956) by the possession of a plicate sinus on the pedicle valve.

Camarophorinella Licharew (1936), another sub-genus of the junior synonym *Camarophoria*, is similarly invalid because the type species has not been described. *Camarophorinella* was defined on the absence of intercamarophorial plates and the nature of the hinge-plate. The intercamarophorial plates are independent of the median septum, rest against the base of the tornydium and wedge into the hinge-plate. They have only been observed in some Russian species, for example *S.* (*Camarophoria*) *superstes* (Verneuil), and have not been described from the type species of either *Camarophoria* or *Stenoscisma*. The absence of these plates, therefore, cannot be used as a diagnostic feature in the designation of a new sub-genus.

The term 'tornydium', proposed by Cooper (1956) for the brachial plate in *Stenoscisma* previously described as a cruralium, appears to be synonymous with the term 'camarophorium' suggested by Kozlowski (1929) for the boat-shaped plate in the brachial valve of *Camarophoria*. The use of the term tornydium is preferred to that of camarophorium because the latter suggests an affinity with the genus *Camarophoria*.

EXPLANATION OF PLATE 12

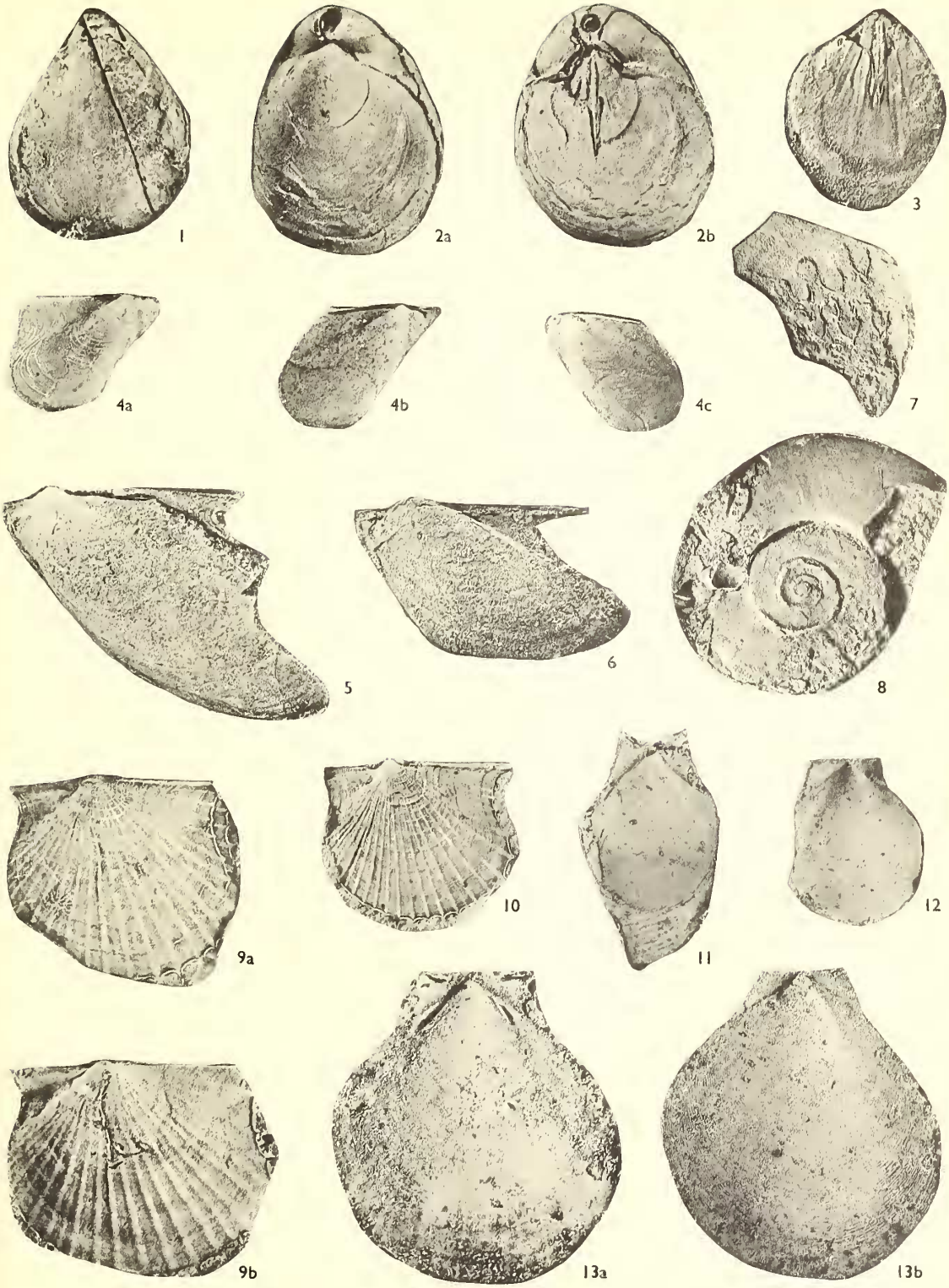
Figs. 1–3. *Dielasma picketti* sp. nov. 1, F. 6670. Internal mould of pedicle valve, × 2. 2*a*, F. 6669. Rubber cast of brachial valve exterior and cardinal region of the pedicle valve; holotype, × 2. 2*b*, F. 6669. Internal mould of the same shell; note the hinge plate and crural bases in the brachial valve, × 2. 3, F. 6673. Internal mould of brachial valve. (L. 53 Greenhills), × 2.

Figs. 4–6. *Diodontopteria delicata* sp. nov. 4*a*, F. 6805. Rubber cast of exterior of right valve; holotype, × 2. 4*b*, F. 6805. Internal mould of right valve showing the anterior tooth; holotype, × 2. 4*c*, F. 6805. Rubber cast of interior of same valve; holotype, × 2. 5, F. 6801b. Internal mould of left valve. (L. 53 Greenhills), × 2. 6, F. 6801a. Internal mould of left valve. (L. 53 Greenhills), × 2.

Figs. 7–8. *Prolecanites sp.* 7, F. 5942. Internal mould of part of one whorl, × 1. 8, F. 5943. Internal mould of the conch, × 1.

Figs. 9–10. ? *Girtypecten sp.* 9*a*, F. 4811. Rubber cast of left valve exterior, × 2. 9*b*, F. 4811. Internal mould of the same valve, × 2. 10, F. 4810. Rubber cast of left valve exterior, × 2.

Figs. 11–13. *Pernopecten trevallynensis* sp. nov. 11, F. 6784. Rubber cast of left valve exterior, × 2. 12, F. 6786. Rubber cast of right valve exterior; paratype, × 2. 13*a*, F. 6783. Internal mould of left valve; holotype, × 2. 13*b*, F. 6783. Rubber cast of left valve exterior; holotype, × 2.



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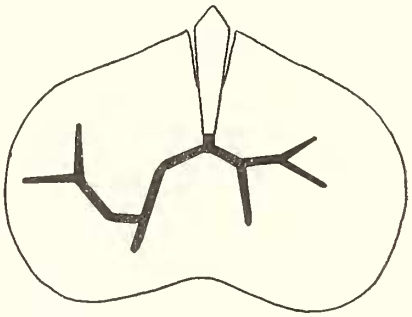
Stenoscisma laevis sp. nov.

Plate 13, figs. 1–4; text-fig. 5

Diagnosis. Pedicle valve rostrate to triangular; median sinus quadrangular, outlined by two low plicae and situated mainly on anterior of valve; floor of median sinus ornamented by from one to three weaker plicae; lateral slopes free of radial ornament but marked by growth lamellae; spondylium narrow, trough-like, extending one-third length of valve; vascula media branching in angular dichotomous style.

Description. External. Pedicle valve rostrate to triangular, with rounded lateral margins; greatest convexity a short distance in front of umbo; lateral shoulders slope evenly from umbo and become marginally flattened; umbo narrow and extending well behind hinge-line; delthyrium open, triangular, and set obliquely to hinge; both the hinge and the palintropes curved; commissure regularly uniplicate; median sinus quadrangular in profile, extended anteriorly into a curved lingual projection; sinus outlined by two broadly rounded plicae and its floor ornamented by from one to three weaker plicae; sinus commences in front of umbo in positions ranging from one-third to one-half length of valve; lateral slopes free from radial ornament but marked by well-defined concentric growth lamellae.



TEXT-FIG. 5. Vascula media trunks in the pedicle valve of *Stenoscisma laevis* sp. nov. (F. 6900, × 3·5).

Internal. Pedicle valve. Spondylium narrow, trough-like, linked posteriorly with dental lamellae, extending one-third the length of valve and supported anteriorly by the median septum; floor of spondylium concave posteriorly, slightly convex anteriorly; median septum thickened at its base, tapers upwards towards the spondylium and protrudes a short distance in front of the latter structure; teeth broad, bluntly rounded and situated at base of delthyrium; vascula media in two sets on raised ridge-like thickenings arising from the anterior extremity of median septum; vascula media branches in typical angular dichotomous rhynchonelloid style (text-fig. 5), the faint terminal channels reaching the margins of valve; small circular genital pits ornament floor of valve.

Measurements (in mm.)

Pedicle valve:

Specimen Number	*Length*	*Width*	*Spondylium Length*
F. 6900	11 est.	15	4
F. 6901*a*	10	10	3·5
F. 6901*b*	11	12	..
F. 6902	10	13	..
F. 6903	10 est.	14	..

Remarks. The brachial valve of *Stenoscisma laevis* has unfortunately not been found. However, the widespread occurrence of this form warrants the designation of a new

species. *Stenoscisma donica* (Rotai, 1931) resembles *S. laevis* in the shape of the pedicle valve and morphology of the median sinus. *S. donica* occurs in the D_1 or Beshevo Limestone of the Donetz Basin which has been correlated with the D_3 (Viséan) of Great Britain. *S. laevis* is readily distinguished from the British Carboniferous species *S. ? isorhynchia* (M'Coy), *S. crumena* (Martin), and *S. ? proava* (Phillips), figured by Davidson (1860), by its smooth lateral slopes and extremely weakly plicate median sinus. *S. bisinuata* (Rowley), as described by Weller (1914) from the Fern Glen Formation and Burlington Limestone of the Mississippi Valley, U.S.A., has smooth lateral margins comparable with those of *S. laevis*. The latter species is distinguished by its more transverse shape and stronger concentric ornament.

The specific name is taken from the Latin *laevis*—smooth, and refers to the smooth lateral slopes of the shell.

Occurrence. *Stenoscisma laevis* has been collected from L. 233 Trevallyn (the type locality), L. 86 Lewinsbrook, L. 53 Greenhills, and L. 234 Wiragulla.

Material. F. 6900–F. 6903. *Holotype* F. 6900.

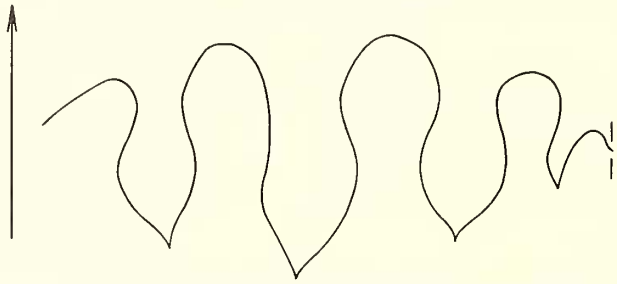
Family PROLECANITIDAE Hyatt 1884
Genus PROLECANITES Mojsisovics 1882

Type species. *Goniatites mixolobus* Mojsisovics, 1882 (under Article 70*b* of the Code of Zoological Nomenclature, non *P. mixolobus* Phillips, 1836) = *P. mojsisovicsi* Miller, 1938, Lower Carboniferous of Germany.

Prolecanites sp.

Plate 12, figs 7–8; text-fig. 6

Description. Conch platyconic, moderately thin, discoidal and evolute; umbilicus wide, exposes all inner whorls and measures 19 mm. in diameter on a conch 45 mm. in dia-



TEXT-FIG. 6. Suture line of *Prolecanites sp.* from Trevallyn. ×4.

meter; whorls number four to five; whorls slightly overlapping, with outer whorl a little more embracing than inner whorls; volutions compressed and flattened laterally; whorl profile more or less rectangular, with a gently rounded ventral surface and a slight dorsal expansion; umbilical shoulders moderately rounded; whorl flanks almost flat away from dorsal and ventral margins; greatest whorl width occurs immediately above dorsal margin; whorl height increases in outer volutions, the outer whorl being four times higher than wide; where the latter is 15 mm. high the adjacent whorl is 6 mm. high;

aperture not observed, but body chamber at least one-third the length of the last volution.

Conch ornamented by faint biconvex ribs, the great majority being restricted to dorsal half of the volution; some stronger ribs run almost to the ventral margin.

At the adult stage the suture contains three sub-equal lanceolate lateral lobes and a smaller curved fourth lateral lobe (see text-fig. 6); ventral lobe obscure in specimens examined, but ventral portion of first lateral saddle runs as though ventral lobe constricted; second lateral lobe largest, slightly asymmetrical, having a ventrally inflected point; third lateral lobe similarly shaped but with no ventral inflection; fourth lateral lobe narrow, sharply pointed, curved slightly dorsally; first lateral saddle high and very slightly asymmetrical; third lateral saddle broad and regularly rounded; fourth lateral saddle relatively large and U-shaped.

Remarks. Compared with *Prolecanites sp.* most European species have a more rounded or blunt fourth lateral lobe and less lanceolate lateral lobes—viz. *P. postapplanatus* Kullmann (1963) from the Cantabrian Mountains of Northern Spain. The American species *P. americanus* Miller and Garner (1953) and *P. monroensis* (Worthen) have sutures with pointed fourth lateral lobes. *P. americanus*, from the Salem or Ste Genevieve Limestone of Illinois, has a similarly shaped fourth lateral lobe; the remaining three lateral lobes have comparable shapes but are unequal in size. *P. americanus* has a more rounded and much wider whorl profile.

P. monroensis, described by Collinson (1955) from the Ste Genevieve Limestone, has a suture with three sub-equal lanceolate lateral lobes and a more or less pointed fourth lateral lobe. It is distinguished from this species by its more rounded and sub-elliptical whorl profile and smaller ratio of whorl height to whorl width.

Occurrence. Prolecanites sp. has been collected from L. 233 Trevallyn.

Material. F. 5942–F. 5943.

Family AVICULOPECTINIDAE Etheridge Jr. emend. Newell 1937
Genus GIRTYPECTEN Newell 1937

Type species. (By original designation) *Aviculopecten sublaqueatus* Girty, 1908, from the Permian of West Texas.

Remarks. The species described below possesses a style of ornament which suggests that it be referred to *Girtypecten*. However, when compared with the type species these specimens have less well-defined secondary costae on the body of the valve and a less pronounced and more irregularly developed concentric ornament. In addition, the marginal spines originating from the costae are hollow in contrast with the solid rod-like spines occurring on the type species.

J. M. Dickins (personal communication) suggests that this material is similar to *Pseudaviculopecten exactus* (Hall) from the Hamilton Group, Lake Canandaigua, New York. He also notes that if the Trevallyn species has a chevron ligament area, which is characteristic of *P. exactus*, these two species could then possibly be included in a separate genus. The lack of specimens prevents any further research into this problem.

Morphologically similar forms have been placed in the genus *Pterinopecten* by Hind (1903) and Branson (1938). *Pterinopecten*, however, is characterized by a much denser external ornament of radiating ribs.